Sustainable Supply Chain Advisory Committee

January Meeting Summary

Date: January 30th | 11 am – 3 pm

Location: In-person at Port of Long Beach and via phone conference

Attendees: Attachment A

Meeting Agenda: Attachment B

Key Discussion Items

(Action items in green)

1. **POLA / POLB Opening Remarks**
   - Chris and Heather kicked off the meeting by providing an update on the status of the draft assessment of clean truck technology assessment, clean truck rate study and the quarterly CAAP meeting.

2. **Review September SSCAC Meeting Summary**
   - Meeting summary was approved. **See attachment C**

3. **CAAP Updates**
   - CAAP updates were addressed during the opening remarks.

4. **Discuss Funding and Resource Prioritization**
   - GNA presented an updated version of the slide deck shared at the last quarterly SSCAC meeting. GNA summarized the updates and work that had been done in response to Committee comments on the first draft in the prior meeting. **See attachment D.**
   - A suggestion made at the previous meeting was reinforced by several members, that "prioritization" also suggests "de-prioritization" and words like "roadmap" and "sequencing" may better describe the need to focus on some activities in the near vs long term according to resource and technology availability. Port representatives suggested that agreement on priorities to sequence funding is useful for their processes. It was also noted that where the SSCAC and other stakeholder can align and agree on priorities, this will help to advocate with a common voice for additional funding and incentives to assist with implementation.
   - Several comments raised the issue of time sensitivity: there needs to be a focus on near-term commercially available technologies that offer an immediate positive impact, while continuing

to support technology development efforts for equipment that may take a decade or more to materialize. It was also suggested that there is no one-size fits all: allowing for diversity within a fleet by pairing fuel technology types with specific drayage profiles to which they are best suited may yield a more actionable strategy. Trucks and cargo handling equipment likely fall into the near-term opportunities for technology upgrades, with OGV falling more into a longer-term opportunity and harbor craft and locomotives falling somewhere in-between.

- The development of a low NOx standard by CARB and EPA was also discussed by the group, as the promulgation of the low NOx engine rule by CARB is a key element of the Clean Truck Program. Other key elements are: the rate study and establishment of the rate; having a collection system in place; and having available technology that allows for the rate to be avoided.
- There was discussion among the group about the development and inputs used for the rate study now being developed, and the review of the rate study findings by all port stakeholders. Several comments were made emphasizing the value of the rate structure study in 2019 for identifying the potential impact on funding resources for on-road fleet upgrades.

5. **Discuss Funding and Resource Prioritization Draft Recommendation**
   - The group reviewed and discussed the development of a draft recommendation which to identify areas for action in the near-term, and areas for ongoing research and project monitoring in the medium-to-long term.
   - ACTION ITEM: GNA will work with the committee members to further development the draft recommendation concept in advance of the next scheduled SSCAC meeting.

   The committee discussed that positive impact is immediately achievable in the following areas, in the near term:

   - Harbor Craft – repower and retrofit tug boats to the Tier 4 standard or better
   - Locomotives – engine upgrades to the Tier 4 standard or better, and other emission reduction technologies.
   - Forklifts – introduce electric forklifts for the smaller capacity units
   - Trucks – pursue deployment of existing zero and near-zero emission drayage technology through innovative engagement with stakeholders across the supply chain, including regulatory and funding agencies.

   The committee discussed providing support for the following activities in the long term:

   - Ocean Going Vessels – assess and invest in solutions for meaningful emissions reductions at key operational stages.
   - Cargo Handling Equipment – monitor and extract lessons learned from ongoing zero and near-zero emission demonstration projects at the ports, and across

California. The committee also recommended that ports continue to implement the CHE recommendation approved in May 2017. **See Attachment E.**

6. **Planning for the 2019 Legislative Session**
   - The group discussed a number of near-term priorities, which included:
     - Prioritizing funding opportunities for more ZE infrastructure that don't have technology purchase requirements, like the recent CEC grant.
     - Advocating for extended liquidation timelines on existing grant programs so there is more time for the ports to install infrastructure.
     - ACTION ITEM: Future opportunities to engage policymakers in Sacramento as a committee. GNA will pursue this in advance of the next committee meeting, to support continued discussion.

7. **Future Agenda Items**
   - The group discussed the following agenda items:
     - Follow up discussion on the draft recommendation, following incorporation of committee comments
     - Follow up discussion on policymaker engagement in 2019

Attachment A

Meeting Attendees

SSCAC Committee Members	
Adrian Martinez	Earth Justice
Michele Grubbs	PMSA
Thomas Jelenic	PMSA
Stella Ursua	GRID Alternatives
Cynthia Marvin	CARB
Bonnie Soriano	CARB
Matt Miyasato	SCAQMD
Zorik Pirveysian	SCAQMD
Michele Grubbs	PMSA
Cody Rosenfield	CCA
Louis Dominguez	San Pedro Neighborhood Council
Steve Cadden	CRT
Los Angeles Port & City Staff	
Chris Cannon	Port of Los Angeles
Tim DeMoss	Port of Los Angeles
Erick Martell	Port of Los Angeles
David Libatique	Port of Los Angeles
Michael Samulon	City of LA, Mayors Office
Irene Burga	City of LA, Mayors Office
Max Reyes	City of LA, Mayors Office
Jacob Haik	City of LA
David Reich	City of LA, Mayors Office
Long Beach Port & City Staff	
Heather Tomley	Port of Long Beach
Renee Moilanen	Port of Long Beach
Meeting Facilitation Staff	
Erik Neandross	GNA
Lexi Wiley	GNA
Patrick Couch	GNA
Eleanor Johnstone	GNA

Attachment B

Meeting Agenda

1. POLA / POLB Opening Remarks

2. Review & Finalize November Meeting Summary

3. Funding & Resource Prioritization Discussion

4. Lunch

5. Discuss Funding & Resource Prioritization Recommendation

6. Planning for the 2019 Legislative Session

7. Future Agenda Items

8. Next SSCAC Meeting: **March 27**
   Agenda Topics:
   - Develop 2019 / 2020 committee priorities
   - Update presentation from SCE / DWP
   - AMP alternatives roundtable / discussion
   - OGV emissions reductions (i.e., T3 scrubbers, LNG, etc.)
   - Summary of a recent study on LNG as a marine fuel for container ships (Steve Cadden to present)

9. Conclusion & Next Steps

Attachment C

November SSCAC Meeting Summary

Sustainable Supply Chain Advisory Committee

November Meeting Summary

Date: November 28th | 11 am – 3 pm

Location: In-person at Port of Los Angeles and via phone conference

Attendees: Attachment A

Meeting Agenda: Attachment B

Key Discussion Items

(Action items in green)

1. **POLA / POLB Opening Remarks**
   - Chris and Heather kicked off the meeting by providing an update on the status of the draft assessment of clean truck technology assessment, clean truck rate study and details on the upcoming quarterly CAAP meeting.

2. **Review September SSCAC Meeting Summary**
   - Meeting summary was approved. **See attachment C**

3. **CAAP Updates**
   - CAAP updates were addressed during the opening remarks.

4. **Funding Prioritization Presentation & Discussion**
   - GNA presented a slide deck summarizing work that had been done on a funding prioritization matrix. **See attachment D.**
   - Several comments, recommendations and suggested edits to the matrix were provided by members of the committee.
     - Action item: GNA to update matrix and slides for review during next meeting.
   - A suggestion was made the "prioritization" also suggests "de-prioritization" and words like "roadmap" and "sequencing" may better describe the need to focus on some activities in the near vs long term.
   - Several comments raised the issue of time sensitivity: there needs to be a focus on near-term commercially available technologies that can help with near-term (2023) NAAQS attainment deadlines and a cautious approach taken on technologies that may take a decade or more to materialize. It was also suggested that there needs to be near-term and longer-term views on

these issues. Trucks and cargo handling equipment likely fall into the near-term opportunities with OGV falling more into a longer-term opportunity and harbor craft and locomotives falling somewhere in-between.

- Focus on priority emissions was suggested as a way to prioritize forward efforts, however, emission trade off issues was also noted, as were investment trade offs (i.e. if all resources are focused on cleaning up trucks, significant investment in cleaner locomotives cannot also take place at the same time). Trucks were identified as the best place to get both NOx and GHG emissions, thus leading to a prioritization of this application.
- The group discussed key elements to prioritize in the near-term, which include:
    - Trucks are a top priority and the implementation of a clean truck rate should move quickly
    - Aligning funding with regulatory compliance (e.g., upcoming CARB shore power regulation)
    - Capturing as much available grant funding as possible
    - Advocate for more money for ZE infrastructure
    - Ports to focus on ZE infrastructure for terminals, while trucking companies and regional agencies to focus on ZE infrastructure for trucks
    - Provide more funding in the Port Technology Advancement Program (TAP) and focus the TAP on technologies that provide lower emission technologies for locomotives and harbor craft as these are both significant sources of emissions
    - Advocate to the legislature to allow more time than 2 years for complex projects to be completed.
    - Vessels should be a priority given contribution to emissions, however they are difficult to address through funding programs. Possible area for funding advocacy is related to infrastructure for shorepower or at-berth controls.

5. **Planning for the 2019 Legislative Session**
    - The group discussed a number of near-term priorities, which included:
        - Prioritizing funding opportunities for more ZE infrastructure that don't have technology purchase requirements, like the recent CEC grant.
        - Advocating for extended liquidation timelines so there is more time for the ports to install infrastructure.
        - Ensuring the SPBPs are prepared to go after VW settlement funds.
    - Action item: GNA to add this agenda item to a future meeting to continue the discussion

6. **Future Agenda Items**
    - The group discussed the following agenda items:
        - Follow up discussion on the funding prioritization
        - Update presentation from SCE / DWP

7. **Discussion with Electrify America**

- Representatives from Electrify America provided a summary of their organization.
    - They will have about $10 million of funding available in middle of 2019 earmarked for medium- and heavy-duty applications, which could be an opportunity for a POLA/POLB EV charging project. They are currently in the fact-finding stage to determine what project could be the best use of their funds and will make a decision by May of 2019.

Attachment D

Funding Prioritization Presentation

SPBP Needs and Resources Prioritization for Clean Technology Investments

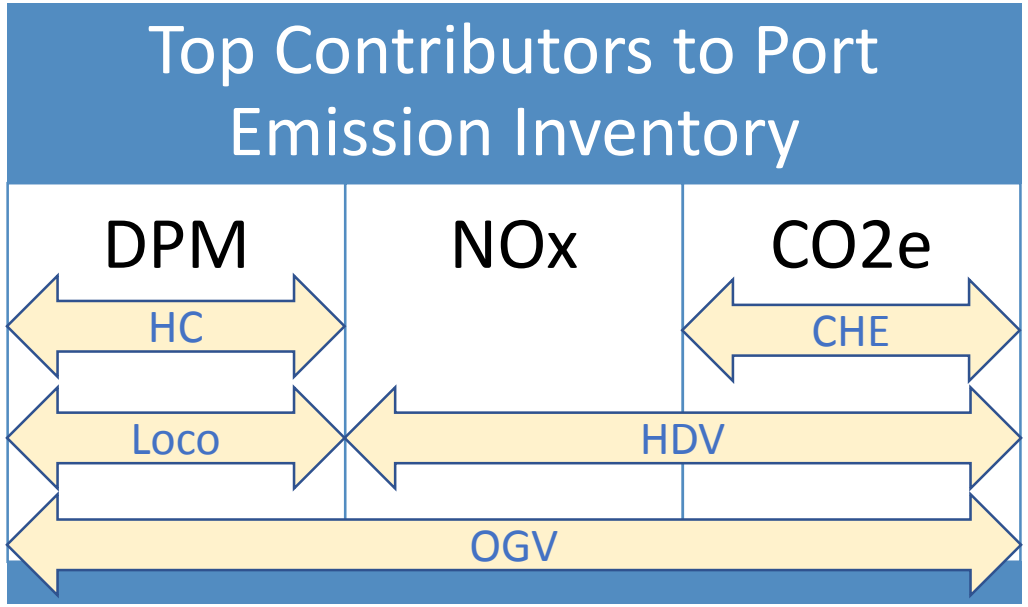
January 30, 2019

Discussion Questions

> With limited resources (financial, staff, etc.), how do the ports prioritize their efforts and investments to reduce emissions from the various sources in a cost- and time- effective manner?"

- How do we weigh/prioritize emissions reductions amongst pollutants? Are NOx, PM, or GHG reductions a higher priority?
- Are there emission tradeoffs?
- Are there co-benefit opportunities?
- What does it mean for a project to be cost effective, recognizing that most projects will be expensive by historic cost effectiveness standards?
- Which technologies are commercially viable today? By 2025? By 2030?
- Are there near term emission reduction opportunities for NOx, PM, and GHGs we should pursue now even though they may not be as high of a priority overall?
- Will regulation drive the same result?
- Where are the potential conflicts/synergies between CAAP goals and new/pending regulations, and how do we resolve the conflicts?
- Will regulation require significant Port investment? If so, how much and will this materially impact the Ports' ability to invest in other measures?
- Are there existing incentive programs that can fund conversion to the goal?
- Can incremental investment drive incremental, near-term and/or cost-effective emission reductions?

Summary of SPBP Emissions Inventories

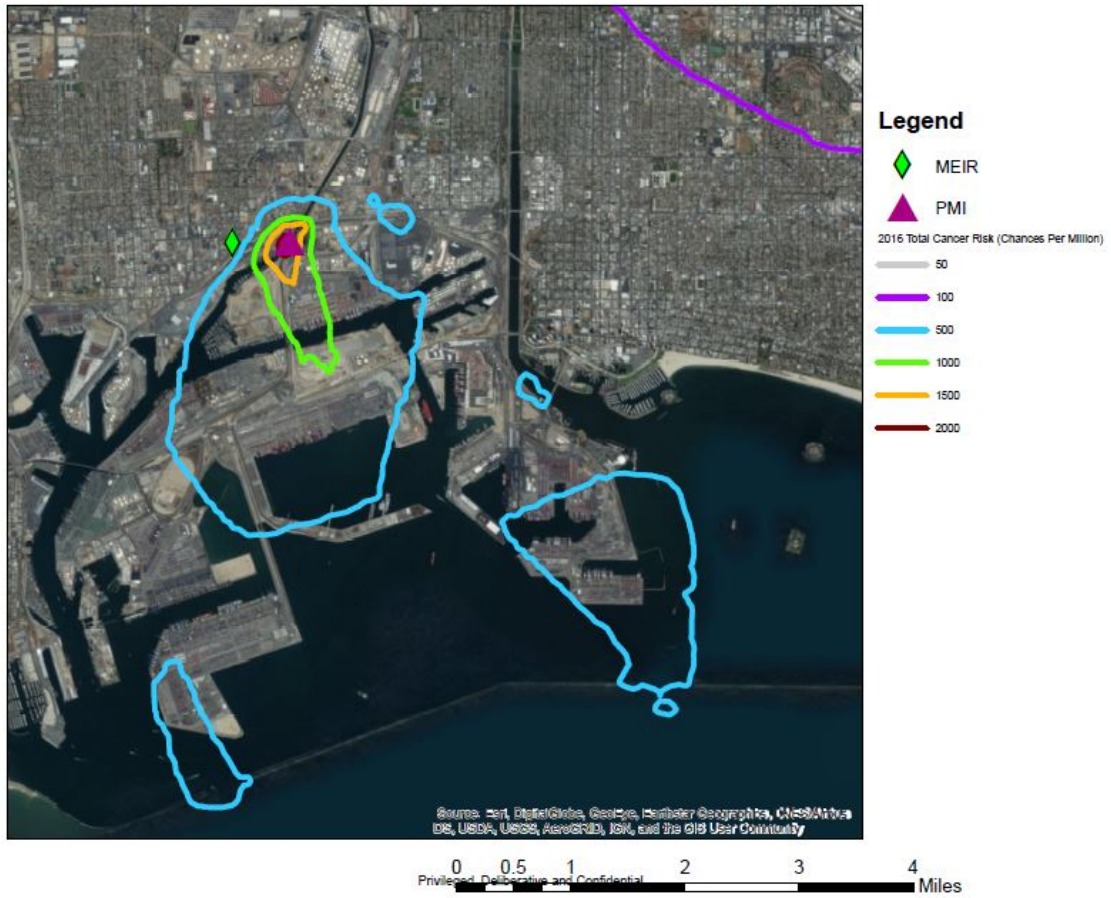


	DPM	NOx	CO2
OGV	48%	54%	30%
HC	19%	10%	6%
CHE	4%	6%	17%
Loco	22%	11%	7%
HDV	7%	19%	40%

- Primary contributors to the emissions inventory vary by pollutant
  - OGVs are the single largest source of pollution
  - HDVs are second with respect to NOx and GHGs
  - Locomotives and Harbor craft are second with respect to DPM
- The “most important” equipment types to address depends on your priorities.

Emissions & Cancer Risk by Equipment Type

Health Risk Study data collection receptors



	DPM	NOx	CO2	Cancer Risk from DPM *(chances per million)*
OGV	48%	54%	30%	43.1
HC	19%	10%	6%	43.6
CHE	4%	6%	17%	8.8
Loco	22%	11%	7%	56.9
HDV	7%	19%	40%	4.9

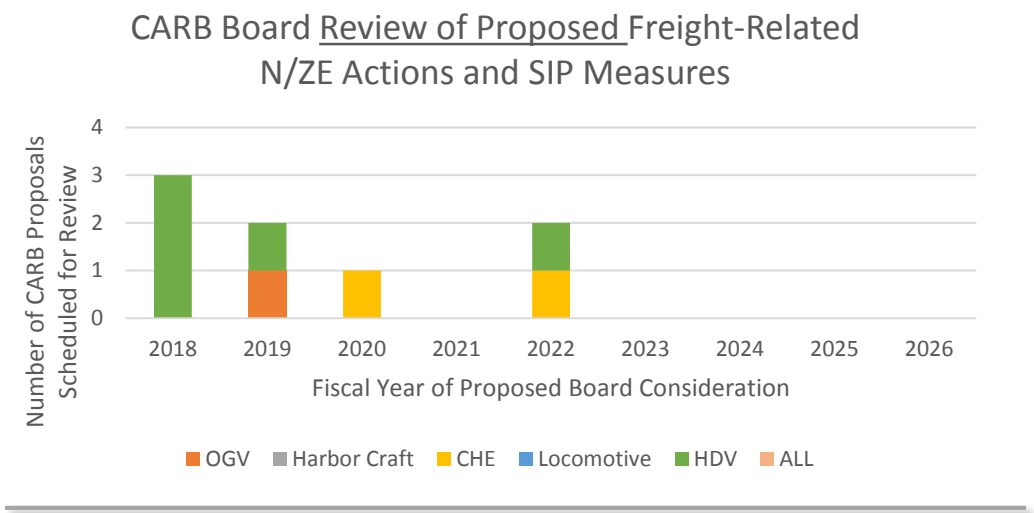
Policy Goals and Strategies

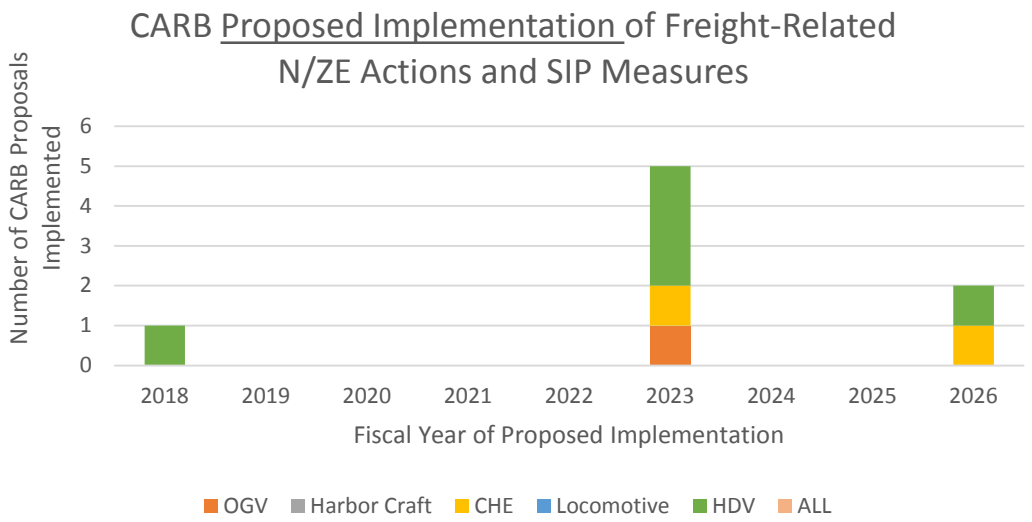
Clean Air Action Plan (SPBP)	State Implementation Plans + Scoping Plan (CARB)	Sustainable Freight Action Plan (State of California)	Air Quality Management Plan (SCAQMD)
Reduce population-weighted residential cancer risk of port-related DPM emissions by 85% by 2020.	Achieve all NAAQS and CAAQS Standards	• Improve freight system efficiency 25% by increasing the value of goods and services produced from the freight sector, relative to the amount of carbon that it produces by 2030. • Deploy over 100,000 freight vehicles and equipment capable of zero emission operation and maximize near-zero emission freight vehicles and equipment powered by renewable energy by 2030. • Increased competitiveness and economic growth. • Reduce toxic hot spots from freight sources and facilities, and ensure continued net reductions in regional freight pollution.	Ensure air quality goals will be met while maximizing benefits and minimizing adverse impacts to the regional economy: • Eliminate reliance on 'future technologies' measures to the maximum extent feasible • Calculate and take credit for co-benefits from other planning efforts • Develop a strategy with fair-share emission reductions at the federal, state and local levels • Invest in strategies, technologies to meet multiple objectives for air quality, climate change, air toxics exposure, energy, transportation • Identify and secure significant funding for incentives to implement early deployment and commercialization of zero and near-zero technologies.
By 2023, reduce port-related emissions by • 59% for NOx *(56% achieved)* • 93% for SOx *(97% achieved)* • 77% for DPM *(87% achieved)*	Reduce GHG emissions to: • 1990 levels by 2020 • 40% below 1990 levels by 2030 • 80% below 1990 levels by 2050		
Reduce GHGs from port-related sources to: • 40% below 1990 levels by 2030 • 80% below 1990 levels by 2050			

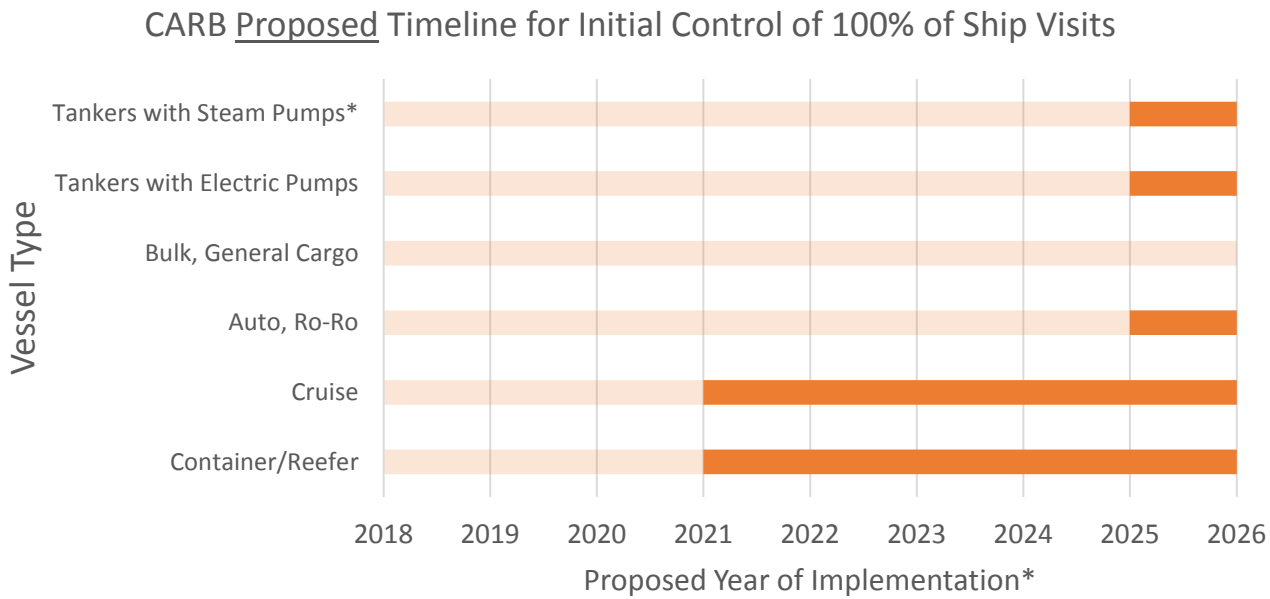
Equipment-specific Commitments to Policy Goals

Equipment Type	Clean Air Action Plan (SPBP)	State Freight Measures (CARB)
OGV	• Advocate for Tier 4/PM engine standard • Maximize participation in vessel speed reduction (VSR) for all vessels within 40 nm of Point Fermin • Demonstrate at-berth emission reduction technologies • Accelerate at-berth emissions reduction technology use requirements through leases where possible	• 80% reduction in at-berth emissions required by 2020 for container, reefer, cruise vessels. • Increase health benefits with new rule to control additional vessel visits, vessel types, equipment, vessel fleets, and ports/terminals. • Current SIP proposal suggests, all vessels must comply with at-berth regulations during 100% of visits by 2030.
Harbor Craft	• Support new fleet turnover requirements • Incentivize Tier 4 engine upgrades in the short-term • Provide, expand infrastructure to support at-berth shore power use	• Establish requirements for lower emissions from in-use and new engines/vessels beginning in 2025
CHE	• All new purchases must be ZE and if not feasible, NZE or cleanest-available, effective 2020. • Support idling restrictions and fleet turnover requirements	• Establish requirements to transition to zero emission operations. • Current SIP proposal suggests, propose a regulation requiring transition to 100% zero emissions equipment beginning in 2026.
Locomotive	• Advocate for Tier 5 engine standard • 50% on-dock rail for cargo transport	• Petition US EPA for more stringent national locomotive (Tier 5) emission standards • Evaluation and potential development of regulations to reduce emissions from locomotives not pre-empted under the Clean Air Act, and to cut idling by rail yard sources.
HDV	• Only NZE trucks may enter SPBP without paying a rate effective 2020 or when State NZE standard is defined. Existing trucks in PDTR continue to operate. • Only NZE trucks may enter SPBP effective 2023 or when State NZE standard is defined. Existing trucks in PDTR continue to operate. • Only ZE trucks may enter SPBP without paying a rate, effective 2035.	• All trucks with engine MY2007 or newer are fully compliant until 12/31/2022 for CA ports and rail yards. • All trucks must have engine MY2010 or newer by 2023. • Establish Low-NOx HD engine standard effective in 2024

Summary of Zero/Near Zero Regulatory Horizon







- HDVs are the focus of the *greatest number* of *proposed* regulatory measures in the short term. HDV measures target emissions reductions and commercialization
- OGV measures target at-berth reductions through shore power or emissions capture and control (cruise, container, reefer, tanker, ro-ro)
- Locomotive petition targets pre-commercial R&D for Tier 5.

List of regulatory measures

Sector/Facility Type	Action
Ship at-berth and at-anchor *(new rule)*	Requires vessels to comply with shore power and/or alternative control technology requirements during 100% of visits.
Commercial Harbor Craft regulation amendments	Amend existing regulation to increase requirements for in-use and new vessels freight- and passenger- vessels. Includes re-evaluating Tier 4 engine feasibility and advanced retrofit ECDs.
Cargo Handling Equipment regulation to transition to zero emissions	Propose an implementation schedule beginning in 2026 for new equipment and facility requirements. Affects all mobile equipment.
Zero-emission forklift regulation	Establish zero-emission performance standards, exceeding the LSI regulation requirements for forklifts.
Drayage truck regulation to transition to zero emission operation	Establish a schedule to phase-in zero-emission drayage truck technology including zero-emission mile capabilities.
Drayage trucks lower in-use performance level	(Multiple regulations)
Drayage trucks vehicles heavy-duty vehicle zero emission certification procedures	Standardize evaluation criteria to validate zero-emission technology performance.
Advanced clean trucks regulation (last-mile delivery)	Accelerate penetration of new class 2b – 8 trucks meeting OLNS or ZE engines in local fleets starting with 2.5% ZEV penetration in 2024, and achieving 15% penetration in 2030.
Low-oxides of nitrogen engine standard	Establish an engine standard that achieves 90% reduction in NOx emissions, and develop regulatory amendments to improve certification requirements for emission control systems operating in low load urban driving conditions.
CARB Proposed Actions Not Incorporated in Critical Regulatory Timeline	
Drayage trucks at seaports and rail yards	Participate in SPBP determination of drayage truck rates to incentivize zero and near-zero emission truck trips
Rail yards, Rail stations, Rail sidings, Seaports, Warehouses, and Other Hubs	Evaluation and potential development of regulation to reduce idling emissions from all rail yard sources and emissions from other stationary locomotive operations
Locomotives	Evaluation and potential development of regulation to reduce emissions from locomotives not pre-empted under the Clean Air Act.
	Petition US EPA for more stringent national locomotive (Tier 5) emission standards
Trucks	Heavy-duty on-board diagnostics amendments
	Innovative truck technology cert flexibility
Off-road equipment	Zero emission off-road emission reduction assessment, and zero emission off-road worksite emission reduction assessment
Transport Refrigeration Units	Regulation to transition to zero emission operations at warehouses, ports, rail yards, grocery stores, etc.

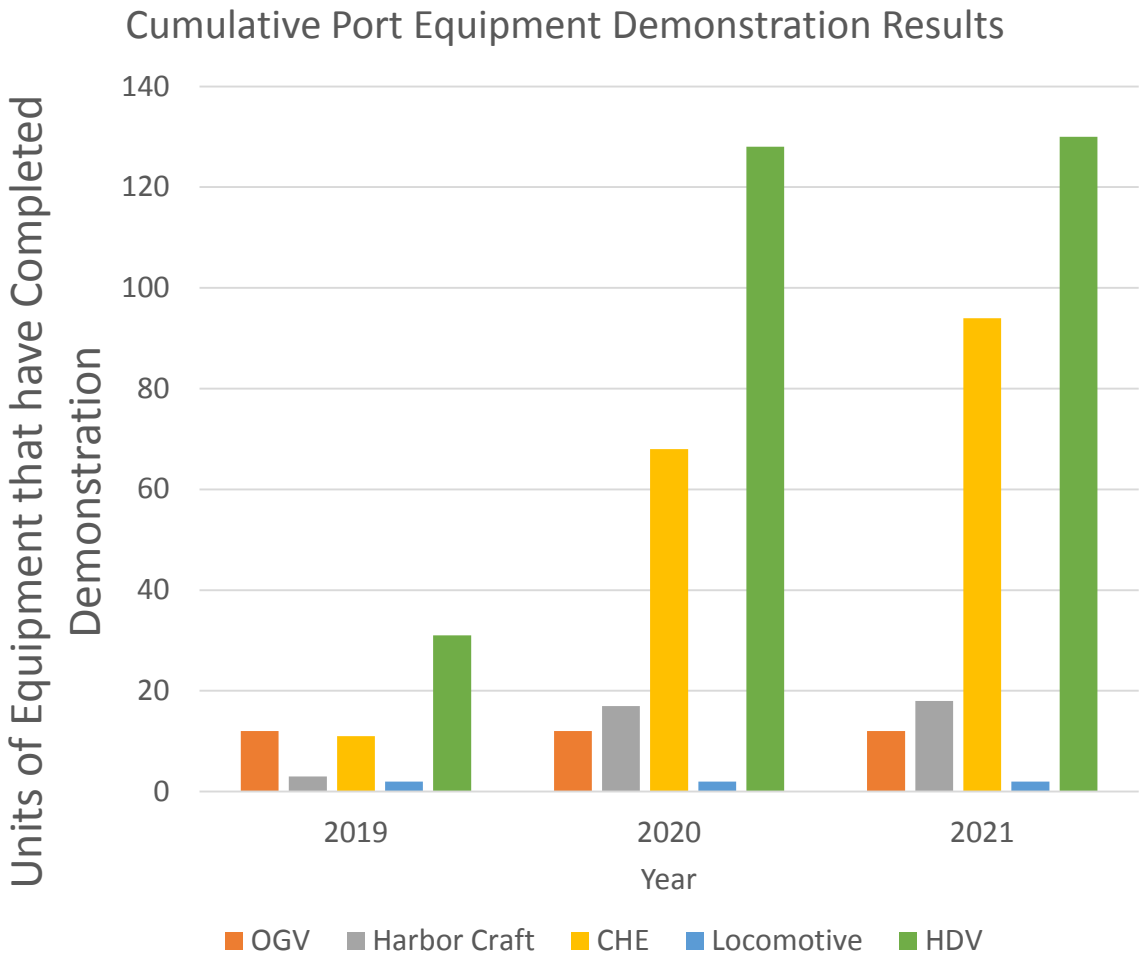
Summary of Near-term Demonstrations

Based on a review of 47 demonstration projects, by 2021:

- CHE and HDV equipment has/will have been extensively tested
  → *Target commercial funding*
- OGV, Harbor Craft and Locomotive are further *behind* in testing
  → *Target demonstration funding*

Project Types by Equipment Category

OGV	Harbor Craft	CHE	Locomotive	HDV
Efficiency, Tier 3 Retrofit	Efficiency, HEV, Fuel Cell	HEV, BEV, NZ NGV, FCV	DPF, BEV/HEV	BEV, NZ NGV, FCV, PHEV, HEV



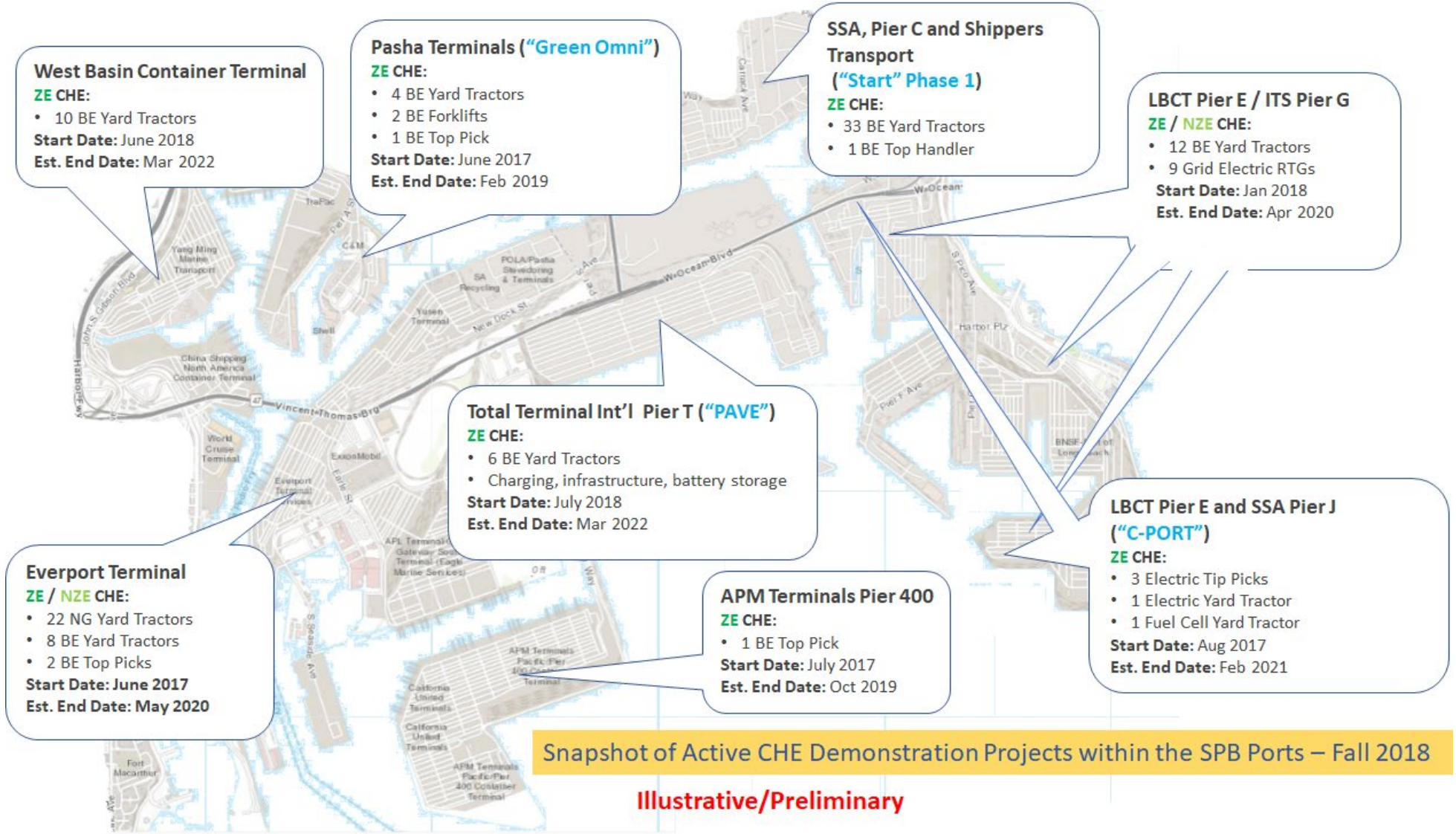
Summary of Near-term Demonstrations

Equipment	Project Title	Technology	Site	Budget ($MM)	Emissions Reduction/yr
OGV	Maersk Ocean-Going Vessel Energy Efficiency Measurement Demonstration	Engine efficiency retrofit	POLA	2.86	2,000-3,000 MT fuel 31,140 MT CO2
OGV	CARB At-Berth Shore Power Regulation Cost Analysis	Shore power	California Ports	6.45	Not Listed
OGV	CARB Ship Retrofit Shore Power Regulation Cost Analysis	Shore power	California Ports	1.18	Not Listed
OGV	START (ZANZEFF)	Tier 3	POLB/Oakland	22	63.79 tons NOx
Harbor Craft	NETT Technologies BlueMAC Nova 320e	Emission control system on tug boat	POLA/POLB	1.2	92% of CO2, NOx and DPM
Harbor Craft	Study to Assess the Feasibility of Tier 4 Engines and Retrofit Aftertreatment on Commercial Harbor Craft	Tier 4 engine swap	POLA/POLB	.199	Not Listed
Harbor Craft	Characterizing Activity and Emissions of In-Use Commercial Harbor Craft	Emissions analysis	POLA/POLB/Oakland	.396	Not Listed
Harbor Craft	START (ZANZEFF)	Tier 4 NZE tugboat	POLB	2.5	1920 MT CO2 4 tons NOx .1 tons DPM
CHE	TransPower electric yard truck demonstration	Yard Tractor	POLA	1.1	Not Listed
CHE	POLA Green Omni Terminal ZE& ZNE Project	Yard Tractor, Forklift, Top Handler, Drayage	POLA	26.6	Not Listed
CHE	Central Valley ZE Yard Tractors	Yard Tractor	Central Valley	3	Not Listed
CHE	BNSF ZE Yard Tractors & Non-Drayage Delivery	Yard Tractor		9.1	3,500 MT CO2 1.625 tons NOx 0.085 tons DPM
CHE	Port of San Diego ZE Yard Tractors and Reach Stacker	Yard Tractor, Reach Stacker	POSD	3	Not Listed
CHE	POLA Everport ZE & ZNE Yard Tractors & Efficient Applications for Trucking	Yard Tractor	POLA	5.8	Not Listed
CHE	POLA APM ZE Top Handler & ZE/NZE Drayage Trucks	Top Handler	POLA	10	Not Listed
CHE	POLB ITS/LBCT ZE Yard Tractors	Yard Tractor	POLB	3.4	(shared with POLB Conversion of LNG trucks to partial ZE Hybrid)
CHE	POLB Pier J: ZE RTGs	RTG	POLB	4.9	(shared with POLB Conversion of LNG trucks to partial ZE Hybrid)
CHE	POLA Everport ZE Yard Tractors & Top Handlers	Yard Tractor, Top Handler	POLA	7.7	Not Listed

Summary of Near-term Demonstrations

Equipment	Project Title	Technology	Site	Budget ($MM)	Emissions Reduction/yr
CHE	START (ZANZEFF)	Yard Tractors	POLB	21.6	4,726 MT CO2 2.21 tons NOx 0.077 tons DPM
CHE	START (ZANZEFF)	Top Handlers	POLB	8.5	218 MT CO2 0.10 tons NOx 0.004 tons DPM
CHE	START (ZANZEFF)	RTG	POLB	11.3	4,905 MT CO2 22.6 tons NOx 0.172 tons DPM
CHE	START (ZANZEFF)	Forklift (large)	POLB	12.1	220 MT CO2 0.11 tons NOx 0.004 tons DPM
CHE	START (ZANZEFF)	Forklift (small)	POLB	5.7	106 MT CO2 0.49 tons NOx 0.016 tons DPM
Locomotive	VeRail Near-Zero Emissions Locomotive Demonstration	Retrofit a switcher to BEV (2018)	POLA/POLB	4.4	85% NOx
Locomotive	Johnson Mathew Locomotive DPF	Retrofit a switcher with DPF (2011)	POLA/POLB	.692	0.02 g/bhp-hr
Locomotive	START (ZANZEFF)	Deploy a zero emission (BEV) rail car mover	POLB	1.9	20.1 MT CO2 0.039 tons NOx 0.0008 tons DPM
HDV	SCAQMD Zero Emission Cargo Transport II Demo	BEV-FCRx, PHEV (NG, Diesel)	SoCal Freight Corridors	19.9	Not Listed
HDV	TTSI - HLT Truck	LNG Retrofit	POLA/POLB	0.075	Not Listed
HDV	ZE Drayage Trucks (CALSTART)	BEV	POLA/POLB	3.7	Not Listed
HDV	ZE Drayage Trucks (CALSTART)	BEV & PHEV (Diesel)	POLA/POLB	.9	Not Listed
HDV	ZE Drayage Trucks (SCAQMD)	BEV-FCRx; HEV (CNG, Diesel)	CTE	10	Not Listed
HDV	SCAQMD ZE Overhead Catenary Drayage Trucks	BEV, PHEV (CNG, LNG)	POLA/POLB	4.2	Not Listed
HDV	Conversion of LNG Trucks to Partial ZE Hybrid	PHEV (LNG) Retrofit	POLB	1.3	1,323 MT CO2 27 tons NOx
HDV	SCAQMD Zero Emissions	BEV, PHEV (CNG, Diesel)	SCAQMD	23.7	Not Listed
HDV	Zero Emission Drayage Trucks	FCV	POLA/POLB	2.7	Not Listed
HDV	Zero Emissions Drayage Trucks	BEV	POSD	5.9	Not Listed
HDV	GTI - Zero Emissions for California Ports (ZANZEFF)	BEV-FCRx	POLA	12	44 MT CO2 0.305 tons DPM
HDV	START (ZANZEFF)	BEV	POLA	17.8	47.08 MT CO2 0.241 tons NOx 0.0103 DPM

Summary of Near-term Demonstrations



Snapshot of Active CHE Demonstration Projects within the SPB Ports – Fall 2018

Illustrative/Preliminary

Technology Analysis - Approach

- Questions to answer
  - What are the expected costs of low/zero emission equipment sold at commercial volumes?
  - What would be the total investment to fully deploy these technologies?
  - Which technologies offer the most emissions reduction per project dollar?
- Data sources
  - Port Emissions and Equipment Inventory
  - ZANZEFF Demonstration Project Equipment, Cost, Emissions
  - Moyer Program grant award records
  - Stakeholder input from project experience

Equipment Commercial Costs as Forecasted in Pre-Commercial Projects (ZANZEFF)

Equipment	Average Demo Unit Cost	Commercial Unit Cost in 4 years	% Change in Price
HC – Tug (Tier 4 HEV)	$18MM	$17MM ($2MM above diesel)	5%
CHE – Yard Tractor (BEV)	$320K	$307K	4%
CHE – Top Handler (BEV)	$1.87MM	$1.42MM	24%
CHE – RTG (BEV)	$600K	$600K	0%
CHE – Large Forklift (BEV)	$418K	$342K	18%
CHE – Small Forklift (BEV	$60K	$53K	12%
HDV (BEV)	$382K	$362K	5%
HDV (NZ NGV)	$165K	$165K	0%
HDV (FCV)	TBD	TBD	TBD

Equipment Commercial Costs from Other Sources

Equipment	Unit Capital Cost	Source
Berth retrofits for shore power	$15.7 MM	POLB analysis
HC – Tug (DPF Retrofit)	$1.2 MM	TAP Project (BlueMax)
HC – Tug (Tier 4 Repower)	$1.9 MM	2017 Carl Moyer program
Locomotives - Switcher (New Tier 4)	$3.0 MM	Texas ERIG program
Locomotives - Switcher (Repower Tier 4)	$1.9 MM	Texas ERIG program

Forecasted Total Investment by 2030**

Equipment	2017 Inventory	Unit Cost	Est. Equipment Cost	Est. Infrastructure Cost
OGV – Container Terminal Shore Power Retrofit	13	$15.7 MM	TBD	$204 MM
HC – Tug boat (DPF Retrofit)	39	$1.2 MM	$46.8 MM	$0
HC – Tug boat (New Tier 4 Hybrid)	39	$17 MM	$663 MM	$0
HC - Tug boat (Tier 4 Repower)	39	$1.9 MM	$71.4 MM	$0
CHE – Yard Tractor	1,693	$307K	$519 MM	$574 MM
CHE – Top Handler	412	$1.4 MM	$602 MM	$587 MM
CHE – RTG	169	$600K	$101 MM	$230 MM
CHE – Forklift (large)	221	$342K	$76 MM	$16.9 MM
CHE – Forklift (small)	536	$53K	$28 MM	$2.1 MM
Locomotives - Switcher (New Tier 4)	23	$3 MM	$69 MM	$0
Locomotives - Switcher (Repower Tier 4)	23	$1.9 MM	$43.7 MM	$0
HDV (BEV)	12,989	$362K	$4.7 B	TBD
HDV (FCV)	12,989	$165K	$2.1 B	TBD*
HDV (NZ NGV)	12,989	TBD	TBD	TBD*

$5.2 to $8.4 Billion

Accounts for 32% of NOx, 22% of PM, and 24-58% of GHGs

* Costs likely to be incorporated into fuel pricing

** Assumes currently-forecasted commercial prices, which are subject to change as existing projects and markets evolve. OGV costs are based on Port experience.

Cost Effectiveness of Demonstration Projects

Equipment	Est. Total Investment	Project Life (years)	Emission Reduction Factors				Cost Effectiveness over Moyer Project Life ($/ton or $/MT)			
			NOx	PM2.5	ROG	GHG*	NOx	PM2.5	GHG*	Weighted Tons
OGV – Container Terminal Shore Power Retrofit	$204 MM	20	55%	30%	-	13%	$25,000	$1,635,000	$1,000	$19,000
HC – Tug boat (DPF Retrofit)	$46.8 MM	5	88%	93%	87%	0%	$15,000	$445,000	-	$8,000
HC – Tug boat (New Tier 4 Hybrid)	$663 MM	16	88%	93%	87%	50%	$76,000	$2,199,000	$2,000	$42,000
HC - Tug boat (Tier 4 Repower)	$74.1 MM	16	88%	93%	87%	0%	$8,000	$246,000	-	$5,000
CHE – Yard Tractor	$1.09 B	5	100%	100%	100%	100%	$1,117,000	$56,507,000	$2,000	$687,000
CHE – Top Handler	$1.19 B	5	100%	100%	100%	100%	$771,000	$105,031,000	$3,000	$616,000
CHE – RTG	$331 MM	5	100%	100%	100%	100%	$424,000	$33,439,000	$3,000	$320,000
CHE – Forklift (large)	$92 MM	3	100%	100%	100%	100%	$2,070,000	$160,391,000	$9,000	$1,542,000
CHE – Forklift (small)	$30 MM	3	100%	100%	100%	100%	$432,000	$26,271,000	$3,000	$265,000
Locomotives - Switcher (New Tier 4)	$69 MM	15	74%	70%	76%	0%	$101,000	$11,020,000	-	$82,000
Locomotives - Switcher (Repower Tier 4)	$44 MM	15	74%	70%	76%	0%	$64,000	$6,980,000	-	$52,000
HDV (BEV)	$4.7 B	7	100%	100%	100%	100%	$278,000	$45,774,000	$1,000	$243,000
HDV (NZ NGV)	$2.1 B	7	90%	0%	0%	15%	$141,000	-	$3,000	$141,000

*GHG Emissions are direct emissions from equipment only, and do not include upstream emissions

Technology Analysis Summary

		Technical Maturity			Cost Effectiveness				Impact		
Equipment	Technology / Strategy	Commercial Availability (2018)	Units in Demonstration	Units in Service (not demos)	Estimated Cost Effectiveness				Relative Fraction of SPBP Inventory Reduced		
					NOx	PM2.5	GHGs	Weighted Tons	NOx	PM2.5	GHGs
OGVs	Shore Power	High	High	High	$25,000	$1,635,000	$1,000	$19,000	3.7%	3.0%	1.0%
Harbor Craft	Retrofit	Low/Medium	Low	None/Low	$15,000	$445,000	N/A	$8,000	4.8%	8.9%	0.0%
Harbor Craft	Hybridization	Low	Low	None/Low	$76,000	$2,199,000	$2,000	$42,000	4.8%	8.9%	1.7%
Harbor Craft	Repower Tier 4	Medium	Medium	Medium	$8,000	$246,000	N/A	$5,000	4.8%	8.9%	0.0%
CHE - Yard Truck	Electrification	Low/Medium	High	Low	$1,117,000	$56,507,000	$2,000	$687,000	1.5%	1.6%	8.5%
CHE - Top Handler	Electrification	Low	Low	None	$771,000	$105,031,000	$3,000	$616,000	2.4%	1.0%	5.3%
CHE - RTG	Electrification	High	Medium	Medium	$424,000	$33,439,000	$3,000	$320,000	1.2%	0.8%	1.4%
CHE - Lg. Forklift	Electrification	Low	None/Low	None	$2,070,000	$160,391,000	$9,000	$1,542,000	0.1%	0.1%	0.2%
CHE - Sm. Forklift	Electrification	High	None/Low	Medium/High	$432,000	$26,271,000	$3,000	$265,000	0.2%	0.2%	0.2%
Locomotives - Switch	New Tier4	High	Low	Low	$101,000	$11,020,000	N/A	$82,000	0.4%	0.2%	0.0%
Locomotives - Switch	Repower Tier 4	High	Low	Low	$64,000	$6,980,000	N/A	$52,000	0.4%	0.2%	0.0%
HDVs	Electrification	Low	Medium	Low	$278,000	$45,774,000	$1,000	$243,000	19%	6%	40%
HDVs	NZ Natural Gas	High	High	High/Medium	$141,000	N/A	$3,000	$141,000	17%	0%	6%

Discussion Questions

	DPM	NOx	CO2	Cancer Risk from DPM *(chances per million)*
OGV	48%	54%	30%	43.1
HC	19%	10%	6%	43.6
CHE	4%	6%	17%	8.8
Loco	22%	11%	7%	56.9
HDV	7%	19%	40%	4.9

- How do we weigh/prioritize emissions reductions amongst pollutants? Are NOx, PM, or GHG reductions a higher priority?
- Are there emission tradeoffs?
- Are there co-benefit opportunities?
- What does it mean for a project to be cost effective, recognizing that most projects will be expensive by historic cost effectiveness standards?
- Which technologies are commercially viable today? By 2025? By 2030?
- Are there near term emission reduction opportunities for NOx, PM, and GHGs we should pursue now even though they may not be as high of a priority overall?
- Will regulation drive the same result?
- Where are the potential conflicts/synergies between CAAP goals and new/pending regulations, and how do we resolve the conflicts?
- Will regulation require significant Port investment? If so, how much and will this materially impact the Ports' ability to invest in other measures?
- Are there existing incentive programs that can fund conversion to the goal?
- Can incremental investment drive incremental, near-term and/or cost-effective emission reductions?

Recommended Investments for Immediate Achievable Impact

Harbor craft – Repower and retrofit tug boats to the Tier 4 standard where applicable.

Locomotives – Complete the upgrade of Pacific Harbor Line's (PHL) locomotives to the Tier 4 standard and explore opportunities to deploy lower or zero emission technologies within the PHL fleet.

Forklifts – Replace smaller capacity forklifts with zero emission equipment where such equipment is commercially available and viable.

Trucks –

- Pursue the deployment of zero and near-zero emission drayage technology in the port fleets with an emphasis on replacing inventory in the pre-2010 model year category.
- The current estimated cost to fully replace the ports' drayage fleet with readily-available zero and near-zero emission technology is over $1Bn, therefore we recommend the ports continue to engage truck OEMs, regional dealerships, finance and leasing companies, other relevant stakeholders to develop innovative approaches to accelerate deployment while maintaining the competitiveness of the ports. In parallel, the ports need to aggressively collaborate with the agencies able to contribute financial resources towards this goal, including CARB, SCAQMD, CEC, DOE, EPA, and others, which is necessary to achieve a large-scale deployment in 3-5 years.

Recommended Areas for Continued R&D

Locomotives – Work with Union Pacific and BNSF to identify strategies and opportunities to bring their Tier 4 or better locomotives into port related activities, ensuring that increased on-dock rail provides an air quality benefit for communities. In addition, use the San Pedro Bay Ports Technology Advancement Program to support development and demonstration of locomotives capable of zero emission operation.

Ocean-going Vessels –

- Continue to assess and invest in viable solutions that facilitates meaningful OGV emissions reductions while in transit or at berth.
- Continue to work with CARB to inform pending shore power regulations by assessing the impact and value of the infrastructure upgrade investments that these rulings would require.
- In parallel, continue to assess the needs and development opportunities for alternative emissions capture systems for OGVs that are otherwise incapable of using traditional shore power technologies.

Cargo Handling Equipment – Continue to carefully monitor and extract lessons learned from the ongoing zero and near-zero emission demonstrations at the ports and throughout California. In addition, the Committee recommends that the ports continue to implement the CHE recommendation approved in May 2017.

Appendix

Potential Solutions Snapshot: OGV Emissions and Strategies

OGV Share of SPBP Emissions by Engine Mode			
	DPM	**NOx**	**CO2e**
Transit	22%	29%	9%
Maneuvering	5%	5%	2%
Hotelling at-berth	15%	15%	16%
Hotelling at-anchor	5%	5%	4%

Transit Emissions Control Solutions	Hotelling at-berth Emissions Control Solutions
• Selective Catalytic Reduction (effective at high-speed) • Vessel Speed Reduction • Engine de-rating • Engine repower (Tier 3, 4)* • External equipment and design alterations (propellers, bow)	• Selective Catalytic Reduction • AMP connection/shore power • Engine repower (Tier 3, 4)

Potential Solutions Snapshot: HC Emissions and Strategies

Harbor Craft Share of SPBP Emissions by Engine			
	DPM	**NOx**	**CO2e**
Auxiliary	1%	1%	0%
Propulsion	18%	8%	6%

Propulsion Emissions Control Solutions	Auxiliary Emissions Control Solutions
• ADPF • SCR • Hybridization • Engine repower (Tier 3, 4)	• ADPF • SCR • Hybridization • Engine repower (Tier 3, 4)

Potential Solutions Snapshot: Loco Emissions and Strategies

Locomotive Share of SPBP Emissions by Vehicle Type			
	DPM	**NOx**	**CO2e**
Switch	0%	1%	1%
Line	15%	7%	5%

Switcher Emissions Control Solutions	Line Haul Emissions Control Solutions
• DPF • Engine repower • Hybridization	• DPF • Engine repower • Hybridization

Attachment E

CHE Recommendation

Cargo Handling Equipment Recommendation

The members of the Sustainable Freight Advisory Committee have reached agreement on proposing the following process for identifying opportunities for air pollution and greenhouse gas emission reductions from cargo handling equipment. Initial positions on cargo handling equipment recommendations varied widely and many members made significant compromises and accommodations to reach a consensus on this proposal. As such, this recommendation may not represent the preferred alternative of any individual member of the committee but a reasonable and viable process on how to address this complicated and controversial issue upon which all committee members could agree.

1. **Opportunity Study**
    a. Complete a detailed study of the terminals within the Port to identify the best potential opportunities for the deployment of zero and/or near-zero emission cargo handling technology and supporting fueling infrastructure.
    b. Work with each Port terminal to identify the equipment to be replaced with zero and/or near-zero emission technologies. Such equipment could include, but is not limited to:
        (1) Ship to Shore cranes
        (2) RTGs
        (3) Forklifts
        (4) Yard hostlers
        (5) Pickup trucks
        (6) Top picks
        (7) Other TBD
    c. Review the Port emissions inventory to confirm which groups of equipment represents the largest sources of emissions.
    d. Work with fuel providers and LADWP (via POLA/DWP committee) to understand the requirements, costs, timelines and other key considerations to develop the necessary refueling / charging infrastructure, and the anticipated delivered fuel costs to the end-user
        (1) Provide an infrastructure development plan to document the total costs for each Port terminal facility to transition to zero and/or near-zero emission alternatives
        (2) Determine the total potential fuel and/or electrical power load for each facility and identify a pathway to serve this fuel/power demand
        (3) Study how integration of renewables and energy storage could aid in reducing rates and lifecycle emissions
    e. Determine the estimated costs, emission benefits, efficiency improvement, and estimated implementation timeline for a transition to zero and/or near-zero emission alternative technologies, fueling infrastructure and fuel within each terminal facility and overall for the Port.

f. Develop concepts, cost structures and incentives required to facilitate the aggressive transition of CHE to zero and/or near-zero emission alternatives.

2. Multi-Port Clean Tech RFIs

a. Work with industry representatives to develop an "equipment requirements" document for each major piece of equipment.

b. Coordinate with other ports to develop and issue an RFI for zero and/or zero emission equivalent technology (prioritize the RFI based upon the findings from Task 1.a., 1.b. and 1.c.).

3. Project Development

a. Advocate to have CARB, CEC, SCAQMD, others allocate funding for port / goods movement zero and zero emission equivalent deployment.

b. Aggressively seek funding for projects that show promise via Task 1 –Opportunity Study.

c. Use the Opportunity Study (above), “Score Board” (below) and “gap analysis” to identify best opportunities for new deployments of zero and near-zero emission equipment in on-road and off-road port applications.

4. Share Success Stories & Best Practices

a. Develop and publish a "Score Board" for funded zero and/or near-zero emission truck and CHE projects in on and off road applications. In the scorecard, confirm:

(1) Which are port related and which are not.

(2) Status: funded; on order; operational; other.

a. Measure data and showcase projects like Green Omni, Everport and other demonstration efforts to encourage regional learning and replication (i.e. share results).

(1) Develop "Best Practices" guide based upon results; POLA to update annually.

(2) Uses data from this task to assist in the development of the 2020 and 2025 CHE feasibility studies noted in the Draft CAAP Discussion Document.

b. POLA to host an annual event on zero and/or near-zero emission deployment efforts in order to share the latest information and successes with Port terminals, equipment providers and other stakeholders. The event should:

(1) Showcase success stories and best practices

(2) Showcase technology and innovation

(3) Share info among terminals